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OF

THE ROYAL ASTRONOMICAL SOCIETY OF CANADA

DEVOTED TO THE ADVANCEMENT OF ASTRONOMY AND ALLIED SCIENCES

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Articles PAGE

The Total Solar Eclipse of 1932, with Plate VI - - - *G. Harper Hall* 337

The Minimum Masses of Seven Spectroscopic Binary Stars - *J. A. Pearce* 345

Radio Talks over CFCT—53, Shadows—54, Shadows of the Planets—55, Eclipses of the Sun I—56, Eclipses of the Sun II *W. E. Harper* 349

The Falling Perseids (Poem) - - - *Bertram Hoffman* 359

News and Comments

Visit of Eclipse Party to Victoria, with Plate VII - - - *H. Boyd Brydon* 360

Review of Publications

Kosmos, by W. de Sitter; *Eclipses of the Sun*, by S. A. Mitchell *C. A. C.* 364

Notes and Queries

The Solar Eclipse of August 31—The International Polar Year —The Laying of the Cornerstone - - - *C. A. C.* 366

Meetings of the Society

At Ottawa—At Victoria—At Edmonton—At Hamilton - - 370

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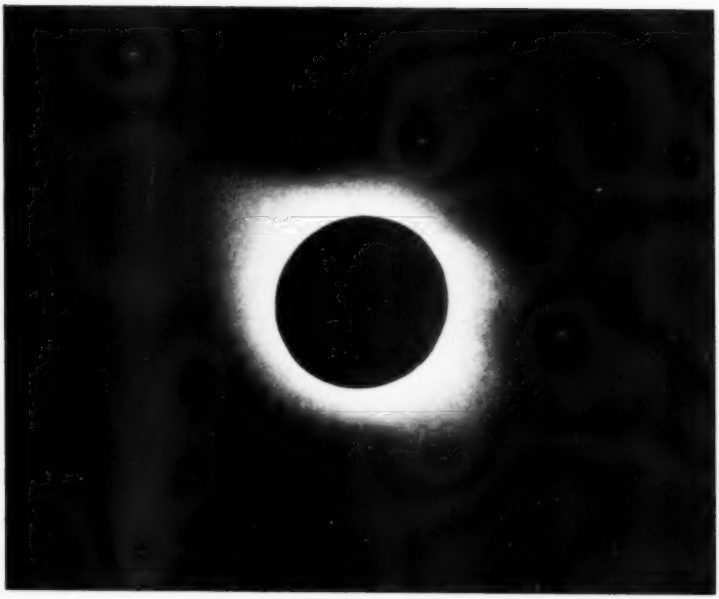
PLATE VI



THE SOLAR CORONA, AUGUST 31, 1932

Photographed by G. Harper Hall at Maskinongé, P.Q. Focal length of lens, 26 inches; stop F/8; exposure, 2 seconds (magnified 4 diameters).

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THE TOTAL SOLAR ECLIPSE OF 1932

By G. Harper Hall

(With Plate VI)

THE comparatively few who were fortunate to see the total solar eclipse of August 31 witnessed a spectacle of exceptional grandeur. While thousands in the path of the shadow were doomed to disappointment, nature bestowed her special favours on at least one small amateur group, assembled near the little village of Maskinongé. The exact spot, which proved to be one of the best in Canada, is two miles west of the bridge over the Maskinongé river and approximately five hundred yards north of the Montreal-Quebec highway.

This position was decided on in July after visits to several points of vantage, including Mount Orford, Eastray, and St. Hilaire. Several reasons led to the choice. The chances of a clear sky were slightly better north of the St. Lawrence. The field was easily reached, requiring the least possible trouble in transportation. It was close to, yet completely hidden from, the highway; a matter of importance if disturbance was to be avoided. It was on an eminence near the centre line of totality, commanding an extensive view in all directions, especially to north-west and south-east along the path of the shadow. There was a ravine through which flowed a small stream, and pasture land with clumps of trees in the vicinity, and as was expected on the 31st, there were grazing animals, birds and

many species of insects favourably situated, for those members of the group intent on observing animal behaviour.

The group included Mr. W. Graves, Mr. and Mrs. C. Hassell, Master Hassell, Mr. and Mrs. E. Fossum, Mr. and Mrs. F. T. Clayton, Misses S. and B. Smardon, Misses I. and J. Harris, Mr. A. Winn, President, and Mr. J. Buckle, Secretary of the Entomological Society of Ontario (Montreal Branch), Mr. H. Mousley, of the Bird Society, the writer, and Mrs. Hall. The Rev. W. E. and Mrs. Cockram also joined us on the field, having motored over two hundred miles from Ontario.

At 1.30 p.m., the prospect of seeing any part of the eclipse was extremely remote, over 90% of the sky being covered with clouds. The moments that followed were tense and the dramatic way the clouds opened added to the thrill of that memorable afternoon. At 2.13 E.S.T., there was a small rift which widened like the iris diaphragm of a camera lens, revealing the sun in a small patch of clear sky. Then, a few seconds after 2.14, we witnessed the first contact, and three minutes later the sun was again obscured. From this time till 3.05 p.m., the cloud curtain was four times drawn and closed as by an invisible stage manager, giving each time a fresh view and an opportunity to photograph the encroaching moon. At 3.12 p.m., as the darkness was deepening, the clouds began to break, and there appeared a large rift immediately south of the sun. The strain was intense till two and one-half minutes before totality, when the sun appeared shining in a clear blue sky. The visibility was perfect. The tense anxiety of the preceding moments only deepened the awe that now fell upon us. Only an occasional word was spoken. The light was indescribable; green and yellow. There was some purple too. The linen sheets stretched to receive the shadow bands, changed from white to aluminium and finally became iridescent. Notwithstanding the darkness, the last rays of sunlight cast shadows of our figures and other objects, with extraordinary sharpness. Several members of the group noticed at this stage the onrush of the shadow from the Laurentian hills to the north-west. The very fine crescent of remaining sunlight at last broke up. There were one or two faint "beads", then a great flash of white light intermingled with a few colours of the spectrum. It was not

unlike the sudden glow from an electric bulb when the filament is burned up by too great a voltage. Instantaneously, the corona flashed out with the planet Jupiter brightly shining near by and a little to the right the star Regulus. Photographs taken immediately before totality show the inner edge of the corona, but it was not visible to the eye till all direct sunlight was cut off. As was expected at a period of minimum sun spots the corona had beautiful equatorial appendages, extending out more than the sun's diameter on each side, a little farther than any of the photographs show. The exquisite beauty of the scene surpassed our expectations. No photograph or painter's brush could do justice to it. Even at this favoured locality, the period of totality passed all too quickly. There was a flash from the western edge of the moon, similar to that on the opposite edge prior to totality, the corona and Jupiter instantly disappeared, and the eclipse of 1932 was over.

Mr. Clayton operated a camera with a lens focus of nearly 40 inches, and the writer one of 26-inch focus. Cameras of shorter focus were used during the partial phases with fair success. There were no prominences seen with the naked eye, but a field glass revealed some and they appear on the photographs. Some interesting examples of reversal or solarization were obtained, the image showing up on development as a positive instead of a negative.

The degree of darkness during totality was not so great as was anticipated. Various estimates were made, my own gauged by the markings on the dial of the stop-watch was .25 foot-candles, *i.e.*, one candle at a distance of 2 feet, or about twelve times brighter than full moon.

It was the purpose of the group, apart from merely viewing the phenomenon, to endeavour to secure some information of value. Several members therefore undertook definite observations. Mr. Hassell devoted his whole attention to taking temperatures and other meteorological records. A well designed weather vane, pivoted on a needle point, was erected on a pole 9 feet above the ground. The wind pressure was also recorded by means of an up-to-date air meter, giving the velocity in feet per minute. This was placed only four feet from the ground to facilitate the reading of the dial. The cloud percentage is the average estimate of four careful observers

working independently, but arriving at figures remarkably close to one another. All the temperatures were taken by means of a registered sling thermometer. As a check on the readings, a self-registering thermometer driven by clock-work was stationed nearby.

EAST. STD. TIME	TEMP. °F.	WIND DIREC-TION	WIND VELOCITY FT./MIN.	CLOUD %	EAST. STD. TIME	TEMP. °F.	WIND DIREC-TION	WIND VELOCITY FT./MIN.	CLOUD %
1.30	78	S.S.W.	475	95	3.18	75			
.35	79	W			.19	75			
.40	76	S.W.			3.20	74	S	17	55
.45	78	W.N.W.	380		.21	74			
.50	76	W.N.W.		90	.22	74			
.55	76	N.W.			.23	74			
2.00	78	S.S.W.	165		.24	73			
.05	78				.25	73	S	122	
.10	80	N.W.			.26	73			60
.15	84	W	195		.27	73			
.20	80	NW	245		.28	73			
.25	77		188		.29	73	S		
.30	78		0		3.30	73		0	
.35	80	WSW	258		.31	73			
.40	79	S	110	80	.32	73			
.45	77	S.W.	141		.33	73			
.50	78	SW	40	85	.34	73			
.55	77		170		.35	73½	S	30	
3.00	76	SW	418		.36	73½			
.05	76		270		.37	73½			
3.10	76	SW	107	75	.38	73½			
.11	75				.39	73½	S		
.12	75				3.40	74	SW	170	80
.13	75				.45	74	WSW	161	
.14	75	SSW	83	60	.50	73½	SW	160	90
.15	75				.55	74	S		
.16	75				4.00	75	SSW	155	
.17	75				4.05	75	S		98

FIG. 1. CHART OF TEMPERATURE, WIND DIRECTION AND VELOCITY, AND PERCENTAGE OF CLOUD

Unfortunately we failed to have a psychrometer on the field, so had to abandon our purpose to take wet bulb readings. A glance at the chart (Fig. 1) will show that the temperature fell 11° between 2.15 p.m. and totality. It also shows the direction and velocity of the

wind and the cloud percentage. At higher levels the wind was fairly constant throughout the period of observation. No nephoscope was used, but the speed of the clouds was estimated at five miles per hour and their height 3,500 feet, mostly cumulus, with another stratum of cirro-cumulus at a height of 9,000 feet.

There was a very heavy dew-fall just before and during totality. Camera focusing cloths and the sheets spread for recording the shadow bands became heavy with moisture and were quite damp after arrival in Montreal, although spread to the breeze till 4.20 p.m.

Mr. Fossum assisted Mr. Hassell until the time for the shadow bands to appear, when he turned his whole attention to observing them.

Two sheets were spread on the ground, one 8×10 feet; the other 8×13 feet, and about thirty yards apart. On the centre of each sheet was an arrow pointing true north. Mr. Fossum remained by sheet No. 1 and marked the shadows as they appeared, with thin pieces of wood. Sheet No. 2 was reserved for observation by others, and in the hope that the shadows could be photographed. This, however, we failed to accomplish. The following observations were made regarding the bands. They were first seen at 35 seconds before totality, and continued till three seconds before totality They reappeared immediately after totality and faded out in 20 seconds. Their general direction of movement both before and after totality was from south to north, but they behaved differently on the two sheets and at different times on the same sheet. On sheet No. 1 the bands, with some exceptions, extended across the sheet and were but slightly waved. Some appeared at the extreme south end, traversed half way, *i.e.*, about 5 feet and disappeared: others appeared at varying distances from the south end, between other bands, and travelled off the sheet at the north end. At first they were about 10 inches apart, but as they became more numerous they closed in to 3½ inches or less, while the bands were about 1¼ to 1½ inches wide. At the south end of the sheet they stretched due east and west, but inclined slightly as they travelled until at the opposite end they had an inclination of 4° from the east and west line, thus resembling the movement of the spokes in a wheel of large diameter. This will be clear by reference

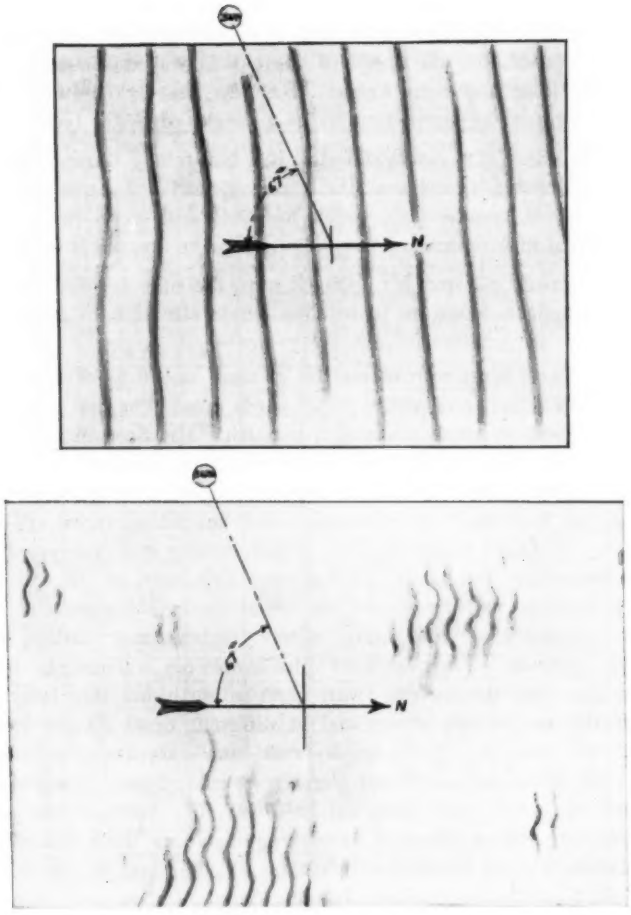

FIG. 2. SKETCHES OF SHADOW BANDS

Above. Sheet No. 1.—Bands 10 in. apart ultimately closing to 3½ in.

Below. Sheet No. 2.—Bands 6 in. apart covered the whole sheet, changing to patches 2½ in. apart.

to the diagram. (Fig. 2). The rate of movement from south to north was approximately one foot per second.

On sheet No. 2, the bands appeared in patches and were decidedly more waved than on sheet No. 1. I personally saw two patches on this sheet as represented on No. 2 diagram, and looked at one patch closely, which was partly on the sheet and partly on the grass. The patch flickered considerably, dazzling the eyes, and had a very slow general movement northwards. The bands were 1¼ to 1½ inches wide, darker at the centre than on the edges, with a space of 1½ to 2½ inches between. Other observers saw this sheet at one time wholly covered with bands about 6 inches apart, but not equally distinct on all parts of the sheet. There is no doubt that the bands were sometimes as far apart as 12 inches, and sometimes as close together as 2 inches.

Some interesting observations were made regarding the behaviour of animals.

The following are only a few extracts from notes made on the field by several observers:

Mr. Mousley records that a small flock of goldfinches (Spinus tristis), was seen near some thistles; and many tree swallows (Iridoprocne bicolor), were busily hawking overhead. As darkness came on, the finches and swallows gradually disappeared to their usual roosting places. Crows (Corvus brachrhynchos), in twos and threes were seen winging their way to roost probably some miles distant. While yet a long way from their accustomed place they were taken unawares by the sudden darkness. They circled and decided to settle in some spruce trees nearby, where they remained till after totality. With the return of light there was the usual concerted cawing as at daybreak in a rookery, when they again took to wing. When the sun was nearly obscured there was a great hush as of impending disaster, not a bird was seen or heard save the crowing of a cock at an adjacent farm. At 3.30 p.m. E.S.T. another day had apparently dawned for the much bewildered birds. They appeared everywhere as by magic while cock crowing became general from every farm, as would be natural at sunrise.

Mr. Winn visited a patch of golden rod (Salidago Sp.), about 60 square feet, and found the usual assemblage of bees, flies and

bugs busy on the flowers. A few sweeps of the net showed that out of 80 specimens taken about 10% were bees. The patch was examined at 2.20, 2.30, and 2.45 p.m., and no diminution in numbers or change in behaviour was noted. When examined, however, five minutes after totality, there were only the humble bees and a few flies left. The visitors had gone to their night quarters. Field crickets were the most abundant insects on the field and kept up an incessant chirping all afternoon. During totality there was a decided diminution in song. The way the sound increased almost immediately the sun flashed out was very noticeable.

A specimen of the common cabbage butterfly (Pieris rapae), chanced to fly across the field at totality, evidently looking for a place for the night. It behaved exactly as did one of its kind when purposely disturbed a few days later at 7.55 p.m., the degree of darkness at the time being approximately the same as at totality.

Sugaring mixture was applied to the trunks of some spruce trees at 3 p.m. Immediately after totality a night moth (Nephelodes minians), was on the mixture, also a small moth (Depressaria Sp.), which is always among the first to arrive after dark. Two other night flying moths (Crambus mutabilis), were caught on the wing.

It is quite safe to say that all the insect life observed reacted to the unnatural oncoming of darkness in the same way as when dusk and night comes on.

Cattle, on the other hand, did not seem to be disturbed. While some cows were seen winding their way homeward, possibly deceived into thinking it was milking time, other cattle and horses continued to graze without interruption. Chickens, however, overtaken by the darkness in the fields, ran excitedly home.

We are under a debt of gratitude to Mr. and Mrs. George Lajoie, who placed their farm at our disposal and did everything possible for the convenience of the group.

Montreal, P.Q.

THE MINIMUM MASSES OF SEVEN SPECTROSCOPIC BINARY STARS*

By J. A. Pearce

DURING the spectroscopic survey of the Class B stars, brighter than magnitude 7.50, which was completed two years ago, at the Dominion Astrophysical Observatory, 117 new spectroscopic binaries were discovered. The spectra of 18 of these stars show double lines, and for these stars it is possible to determine the minimum masses of the components. The determination of the orbital elements and the masses of the more important systems is being undertaken by the author, who is also re-observing a few Class B stars to obtain the elements and masses of the secondary components of the systems.

Spectroscopic orbits have been completed this spring, for seven double-lines systems. The principal elements are given in Table I.

TABLE I—PRINCIPAL ORBITAL ELEMENTS OF SYSTEMS

Star	Types	m	P (days)	e	K_1	K_2
H.D. 57060	O7sfk – O7	4.90	4.39351	0.156	217	288
H.D. 39698	B3k – B5	5.89	7.8271	0.250	74	194
H.D. 29376	B3k – B5	6.89	2.2075	0.076	125	236
H.D. 218440	B3sk – B5	6.28	7.25105	0.376	88	147
H.D. 44701	B5n – B8n	6.58	1.19033	0.036	173	264
H.D. 208095	B7 – B9	6.1	17.3263	0.224	108	166
H.D. 57103	B8 – B8	5.61	2.25960	0.076	106	199

The spectral types range from O7 to B8. The short periods, small eccentricities and large amplitudes are typical of early type spectroscopic binaries.

Notes on the Systems

(1) The orbital elements for the brighter component of H.D. 57060 = 29 Canis Majoris, were derived by W. E. Harper, while at the Dominion Observatory, some 15 years ago. The faint lines

*Presented before the Pacific Division of the A.A.A.S. Pullman, Washington, June 17, 1932.

of the secondary spectrum were not evident on his plates. The recent observations indicate that a small correction to his period is desirable.

(2) H.D. 39698—The binary nature of this star, suspected at the Yerkes Observatory was confirmed by the author. The faint secondary spectrum was measured on 7 plates, at times of maximum separation. The orbital elements were determined from 24 observations; 27 years, 1275 revolutions, separates the first Yerkes from the last Victoria observation. In addition to an interstellar calcium line, stellar calcium lines, oscillating in the same period and with the amplitude of the hydrogen and helium lines were observed. The star is, therefore, another example of those systems of Class B3, which exhibit the coexistence of stellar and interstellar calcium lines.

(3) H.D. 29376—This spectroscopic binary was discovered by the author. The orbital elements were determined from 27 observations. Like H.D. 39698, this is a B3k star, whose spectrum contains both stationary and oscillating calcium lines.

(4) H.D. 218440—S. L. Boothroyd published the orbit for the brighter component of this system in 1921. He reported the coexistence of stellar and interstellar calcium lines on 4 spectrograms. Spectrograms taken recently confirm his observations. The earlier plates were remeasured and the relative masses of the components deduced.

(5) H.D. 44701—This spectroscopic binary was discovered by the author. No difficulty was experienced in obtaining the short period. The orbital elements were determined from 32 observations.

(6) H.D. 208095—This star is the brighter component of the visual double Burnham 11323. 23 spectrograms were obtained from 1925-1928, on 12 of which the secondary spectrum was measured. The period is fairly long and the resulting masses are high for the spectral class. Five observations of the 7.0 mag. companion, Boss 5628, were obtained. The type is A0. The radial velocity is constant, -7.0 ± 1.2 km./sec. which is identical with the velocity of system of the brighter star. The proper motions of both stars are similar in amount and direction; $\mu=0''.018$ in $\psi=80°$. The relative positions have remained unchanged since the observations of F. G. W. Struve in 1832.

(7) H.D. 57103 = 19 Lyncis. An orbit for the brighter component was derived by W. E. Harper in 1918 while at the Dominion Observatory. Faint lines of the secondary star were observed on his plates. Recent observations show that his period has remained quite unchanged throughout the intervening years.

Mass Data

The mass data for these systems are given in Table II.

TABLE II—MASS DATA

Star	Types	$M \sin^3 i$	$m_1 \sin^3 i$	$m_2 \sin^3 i$	$\frac{m_2}{m_1}$
H.D. 57060	O7sfk – O7	56.5⊙	32.2⊙	24.3⊙	0.75
H.D. 39698	B3k – B5	14.2	10.3	3.9	0.38
H.D. 29376	B3k – B5	10.7	7.0	3.7	0.53
H.D. 218440	B3sk – B5	7.7	4.8	2.9	0.60
H.D. 44701	B5n – B8n	10.3	6.2	4.1	0.66
H.D. 208095	B7 – B9	34.4	20.8	13.6	0.65
H.D. 57103	B8 – B8	6.6	4.3	2.3	0.55

The masses of five of the systems are normal for double stars of this class. H.D. 208095, however, is considerably above the average for Class B8. H.D. 57060 is the third most massive system known, being exceeded by H.D. 698, B9sek, minimum mass M = 158⊙, and H.D. 47129, O8eK, minimum mass M = 139⊙, the former investigated by the author, and the latter by J. S. Plaskett.

Interstellar Calcium

The behavoiur of the calcium lines in these systems is an interesting feature. Stellar calcium Ca II, makes its marginal appearance at Class B2, is quite apparent at Class B3, and steadily increases in intensity throughout the B to G Classes, reaching a maximum in Class K. The lines of interstellar calcium which originate in the uniformly distributed cosmic cloud are superimposed upon the spectra of all distant stars. They are characterized by two properties (*a*) narrow quality, (*b*) stationary position. They have always been observed in the spectra of the distant O to B3 stars; found to coexist with the stellar calcium in the spectra of

seven spectroscopic binaries† of Classes B2 to B5; and have been observed in only one spectrum of later type than B5, that is, in the massive B9 star H.D. 698 investigated by the author.

In these systems, the stellar H and K lines are absent in the O7 star, H.D. 57060; faintly present in the B3 stars, H.D. 39698, H.D. 29376 and H.D. 218440; moderately strong in the B5 star, H.D. 44701; and prominent in the B7 – B8 stars, H.D. 208096 and H.D. 57103. The interstellar lines are present in the spectra of the first four stars, but absent in the spectra of the last 3 stars which are too near to support them.

Thus we observe in H.D. 57060 a single calcium line of stationary position; in the three systems of Classes B5 to B8, double calcium lines which oscillate in the same period and with the same amplitude as the stellar lines; and in the three B3k systems, we have three components of the calcium lines; one, a strong narrow line of stationary position which originates in the tenuous intervening cosmic cloud, and two other components whose appearance and motions indicate that they arise in the atmospheres of the revolving stars.

The absolute magnitudes of four systems have been deduced from the intensities of the interstellar calcium lines. They are: H.D. 57060, −4.2; H.D. 39698, −3.4; H.D. 29376, −2.4; and H.D. 218440, −3.0.

Dominion Astrophysical Observatory,
Victoria, B.C.
June 8th, 1932.

†Omicron Persei, B2k (Jordan); H.D. 218440, B3sk (Boothroyd); U Ophiuchi B5k, (Struve); H.D. 39698, B3k; H.D. 29376, B3k; H.D. 25833, B3k and H.D. 214240, B3k, by the author.

RADIO TALKS OVER CFCT, VICTORIA, B.C.

By W. E. Harper

53. Shadows

(November 17, 1931)

THE title of my seven-minute talk with you this evening may seem, on first thought, to have very little connection with astronomy, the branch of science with which all these radio talks are supposed to deal. When we reflect, however, that there would be no such thing as astronomy were it not for the shadow of the earth, which permits us to view the heavenly bodies at night, we readily see that the subject is not outside our scope.

Since a shadow is really an absence of light, it is like light in this respect that it can be seen only when it falls upon something. Occasionally the shadow of our earth falls upon our nearest neighbour, the moon, and then we have a lunar eclipse of which I may speak some time in the future.

Is there any other occasion when we can see the earth's shadow? Yes, there is. When the sky is free from clouds and low lying haze, we can see the shadow of the earth just before sunrise or after sunset projected against the background of the sky. In the latter case, there will be seen a grayish-blue circle that rises above the eastern horizon as the sun descends below the western horizon. This is merely the shadow of the earth and it is often referred to as the "twilight bow." It has seemed to the speaker that the phenomenon is more frequently witnessed in summer time than in winter. It may be that the increased duration of twilight in the summer, coupled with clearer skies, renders it all the more likely to be seen then. There is no reason, however, why it cannot be seen on any clear evening; it is a fact, nevertheless, that very few people ever recognize it.

As twilight deepens into darkness, then from our shaded position on the earth's surface we can see and study the fainter lights, the stars. Occasionally the planets Venus or Jupiter are bright enough to be seen even in the daytime but usually such is the case only if we know exactly where to look for them. For such an observation the chances of success are increased if we get in the

shade of some building where the immediate surrounding glare is cut off. A few years ago newspapers told of immense crowds in the shadow of a tall building both in Winnipeg and San Francisco, who were intently gazing skyward to get a look at Venus in the daytime. Some person had casually glimpsed the planet and believed it to be a strange celestial body.

If one were tempted to philosophize, what more alluring theme could be thought of than this one, that we see things more clearly when in the shadow ourselves. If all is sunshine we may miss the deeper things of life just as a statesman may often visualize more accurately the real needs of his country when he is in retirement. But this is supposed to be astronomy not philosophy.

Shadows have been used from earliest days to tell the season of the year. Everyone is aware that the sun rides higher in the heaven in the summer time than in the winter. In consequence of this the shadow of an upright stick will be much shorter in summer than in winter. For the latitude of Victoria the shadow of an upright stick at noon on December 21st, when the sun's altitude is lowest and consequently the shadow the longest, is between six and seven times what it is at noon of the 21st of June. By keeping records from day to day of the length of the shadow of such an upright wand, the ancients could tell how the seasons of the year were advancing.

In a somewhat similar way, shadows have been used to tell the hour of the day. Many and varied have been the forms the sun dial has taken from primitive times, when a real purpose was served by it, to the present day when such dials are used largely as ornamental features of our gardens. A fuller treatment of sun-dials will have to be given at some other time.

Those who live in mountainous countries know that the valleys do not receive the average amount of sunlight. They are in shadow after the sun has risen and before it has set during an interval which is greater, the greater the heights of the mountains. If the sun should happen to rise behind a particularly high peak the contour of the peak would be traced on the opposite range or extend for miles across the plain. Cases are on record also where low-lying clouds at a distance of a hundred miles or so served as a screen on which

was projected the bold outline of the distant peak beyond which the sun was rising.

Let us carry this idea of shadows to the moon, whose surface is characterized by rather high mountain peaks. A moment ago I suggested how we can tell what the length of the shadow of our stick will be when we know the sun's position in the sky. Conversely, from the shadow we can derive the height of the stick. In a similar manner from the lengths of the shadows cast by mountain peaks on the moon we can derive the heights of the peaks themselves. Everyone who has viewed the moon through even a small telescope knows how clear cut the shadows of the peaks are at the time of half moon when the sun is shining across the moon's surface directly at right angles to our line of vision. This is the best time to view the moon either for a casual view or for the purpose of making measurements upon the shadows, which are then the longest. From such investigations we have learned that the mountains on the moon are more precipitous than those on the earth. Moreover, when the relative sizes of the two bodies are considered a mountain on the moon of 20,000 ft., is higher than any we on the earth can boast of.

Walking westward one evening recently as the sun was setting, I was sharply reminded of the shadows of the lunar mountains by the shadows cast by innumerable small pebbles in the asphalt surface of the road. One could barely detect these little granular elevations otherwise than by their shadows. These were several inches in length and tapered off to a point; they were quite contrasty and left no doubt of their presence.

54. Shadows of the Planets

(December 15, 1931)

IN following up my last address on "Shadows" I wish to-night to enlarge upon what I said concerning the shadow of the earth and to direct attention as well to the shadows cast by the other planets. The shadows of spherical bodies such as the planets are always circular cones and since the sun is far larger than any of the planets the apex of the cone will always be directed away from the central luminary.

Knowing the sizes of the sun and the planets and the distances of each planet from the sun, it is a simple matter to calculate the lengths of the shadows cast by each of them. Of course, these will vary within small limits. In the case of the earth we are nearest to the sun in the winter time and the shadow is somewhat shorter then than in the summer time. The average value for the length of the shadow in each case is as follows (the unit being one million miles); Mercury 0.32, Venus 0.82, Earth 0.86, Mars 0.46, Jupiter 10.36 and Saturn 8.50. These are approximate figures only and refer to the dense portion of the shadow, the so-called "umbra," where theoretically no light enters.

If interplanetary space were slightly dusty, we should see, then, accompanying each of the planets, a long, dark shadow, projecting behind it and travelling with it. Such a shadow, is the space from which sunlight is excluded by the intervening planet. Reference was made in my last talk to the fact that in the case of our own planet we do see such a shadow at times projected against the background of the sky.

Since the shadows of Mercury and Venus, when they happen to come directly between us and the sun, fall far short of reaching to the earth there can never be an eclipse of the sun due to such interposition. Nevertheless, we do see them cutting out a small portion of the sun's light as they move across its disk. In the case of Mercury these "transits" occur in the months of May and November and may happen only once in about thirteen years. The transits of Venus are more infrequent still, the last one occurring in 1882 and the next one in the year 2004. The transits of Venus are decidedly important since valuable information as to the distance of the sun can be obtained on such occasions. Moreover, at these transits, just as Venus is entering upon or leaving the sun's disk, the portion of its own disk outside the sun is surrounded by a line of light, explainable on the assumption of an atmosphere surrounding the planet.

Since the earth's shadow cone extends out 859,000 miles and since the moon is distant only 239,000 miles one can see that when conditions of sun, earth and moon are just right, the moon will pass through the shadow cone of the earth. At such times we have a lunar eclipse. The width of the shadow cone where the moon

crosses it is on the average of about 5700 miles, about two and two-thirds times the diameter of the moon itself. Since the moon's hourly motion eastward in its orbit is about equal to its own diameter, the interval during which the moon is *wholly* within the shadow cone is about one hour and forty minutes. Previous to touching the deep shadow cone and after leaving it the moon will be for a short interval in the "penumbral" region where the illumination by the sun's rays is only partial.

I take it for granted that all of my listeners have observed eclipses of the moon and have wondered why it is that you can see our satelite, even in eclipse. The reason is this. The sun's rays are bent by our atmosphere inward so that there are varying amounts of sunlight projected into the shadow cone. If the weather happens to be clear upon that portion of the earth which corresponds to its rim, as seen by an imaginary observer on the moon, then the amount of light refracted by our atmosphere is very considerable and little darkening occurs. On the other hand, if clouds and storms are the rule, very little light may be so transmitted and an almost perfect eclipse will occur. Such happened about fifty years ago.

Since the moon circles the earth once a month, one might think that an eclipse should occur monthly. The moon, though, usually passes north or south of the shadow cone and two lunar eclipses a year are what may be expected, though, there may be none at all. There are two partial eclipses of the moon in the year 1932, on March 22nd and September 14th.

Let us note briefly conditions on Jupiter. Revolving about it are nine moons, four of which are easily discernible in an opera glass. The closest one takes about two, the fourth one about sixteen days to go around. The shadows of the inner ones are long enough to reach to the disk itself and at times we see the unique phenomenon of both the satellite and its shadow projected upon the disk of the planet, though of course at different places.

The satellites themselves, in their paths about the planet, have to pass behind it and are occulted from our view. At times when the planet is in opposition—that is, when it is rising in the east as the sun is setting in the west—we are looking at the planet exactly in line with the illuminating rays from the sun and a satellite will enter the shadow cone at the same instant as it passes out of our

view behind the planet. But when Jupiter is due south in the sky at the time the sun is setting, we are looking at right angles to the projecting shadow and it is possible that a satellite may be in the shadow, feebly illuminated, and yet visible to us since not behind the planet itself.

Saturn casts a shadow eight and one-half million miles in length. Through the telescope of a friend, the poet Tennyson had seen the shadow of the planet on the well-known ring surrounding it and so he wrote in the poem, "The Palace of Art":

> "Reign thou apart, a quiet king,
> Still as, while Saturn whirls, his steadfast shade
> Sleeps on his luminous wing."

55. Eclipses of the Sun, I.

(January 19, 1932)

MY last radio talk stressed the importance of shadows from the standpoint of astronomy. The shadow of the earth was shown to be conical in form, stretching away from the earth to a distance of 859,000 miles. At certain times which can be accurately foretold the moon enters this shadow and we have a lunar eclipse lasting an hour or so.

The shadow of the moon itself is also conical in form and occasionally at the time of new moon when the moon happens to be *directly* between us and the sun the conditions are just right for an eclipse of the sun. The length of the shadow of the moon just about equals its distance from us, hence only the apex of the cone touches the earth. It is a case of "touch and go," so to speak, and the greatest duration of a solar eclipse never exceeds seven minutes. The eclipse of August 31, in Eastern Canada and the New England States lasts less than two minutes.

Since on the average a total solar eclipse occurs only once in 18 months and since, moreover, many of these occur on inaccessible parts of the earth it can be easily understood that unless one makes special plans to visit the eclipse path the phenomenon is rarely ever seen. And even if one should plan to visit the favoured locality, the possibility of cloudy skies at the critical moment makes it usually a fifty-fifty chance of witnessing the unique event.

An eminent astronomer has calculated that since the time when

modern methods of observing eclipses were started, less than fifty years ago, the total durations of all eclipses of the sun successfully observed have amounted to about one brief hour, or sixty golden minutes. This particular astronomer has been most fortunate as he has successfully observed six out of the last seven eclipses but has had to travel more than 60,000 miles to do so and his total working time for all six combined was only 15 minutes. Eclipse expeditions to distant lands are naturally costly, but if successful they yield a rich harvest of information about our central luminary, the sun.

In the dawn of civilization eclipses of the sun were regarded with a certain amount of dread and even yet, among backward tribes when they happen to be in the shadow path, we have heard of the state of terror and dismay into which they are thrown and how they make a great noise to drive the evil spirits away from the sun. Little by little, however, the cause of such eclipses was learned, though it is just a little less than 100 years ago before anything like a definite plan of observing them was formulated. It has seemed to the speaker that a brief recital of items discovered at different eclipses of the past century might be of interest to those listening in.

The eclipse of 1842 crossed southern Europe and enticed all leading European astronomers to its path. They were startled by the gorgeous display of lurid red streamers extending out in all directions behind the intervening moon and the question was debated as to whether these belonged to the sun or the moon.

The eclipse of 1851 was in Norway and again these wonderful streamers were in evidence. To them was given the name "prominences" and the consensus of opinion favoured a solar origin for them, although several thought they had some connection with the moon.

These prominences become visible the instant totality begins and remain the gorgeous spectacle that they are during the whole time of totality. The moon is all the time shifting to the eastward and it was noted at the eclipse of 1860 across Spain that it covered up the prominences progressively on the eastern edge of the sun while as yet the eclipse was on. Thus these red flames undoubtedly had their origin in the sun.

It was surmised that the prominences were composed of the lighter gases and amongst these hydrogen of course held first

place. As it has a prominent line in the red portion of its spectrum the brilliant red flames were accounted for on this supposition. At the next eclipse of 1868 in India, preparations were made to analyze the light of the prominences and Janssen, a Frenchman, was successful in recording the lines due to hydrogen when he directed the slit of his analyzing spectroscope on the prominences. But there were other lines, especially a yellow one, appearing in the spectrum in positions where from laboratory experience none were known to be. These were ascribed to some unknown element which was given the name "helium."

Hitherto it had been considered that the prominences could be seen only for a few minutes at the time of a total solar eclipse when the moon blotted out completely the light from the main portion of the sun. But photography had now come into general practice at eclipses and it was suspected by Janssen that by covering up artificially the main disk of the sun and allowing only the light from just outside the edge of the sun to enter his analyzer that he might obtain a record of the spectrum lines. He tried it just after the eclipse was over and was successful. Curious to say, the same idea occurred, almost at the same time, to an Englishman, Lockyer, who was not at the eclipse and he, too, without an eclipse obtained the spectrum of the prominences, finding the strange lines due to the unknown element helium. A special medal was struck and presented by the French Academy of Sciences in their joint honour for this discovery. Twenty-five years later the unknown element was found on the earth and, as everyone knows, has become of vast importance commercially. But that is another story.

56. Eclipses of the Sun. II.

(February 17, 1932)

IN discussing eclipses of the sun with you in my last radio talk we learned that the scarlet flames seen shooting outwards from the sun in such rare and all-too-brief moments were found to consist of the lighter gases, mainly hydrogen and another unknown gas which was designated helium.

While these so-called prominences continued to receive attention at eclipses after the one of 1868 in India yet there were other features of eclipses calling for investigation. The analyzed light

of the sun shows thousands of markings or lines which are evidence that in its atmosphere are to be found vapours of almost every element known to exist on the earth. The scheme of things would suggest that the main body of the sun—the light and heat-giving portion—consists of incandescent gases under enormous pressures whilst at increasing distances outward from its surface the gases comprising its atmosphere become correspondingly less dense and lower in temperature. The main light from the sun shining through the outer, cooler, enveloping atmosphere presents a pattern in our analyzing spectroscope in which these spectral lines, numbering thousands appear dark. It seemed then that this surrounding atmosphere would not be luminous of itself, otherwise bright, not dark, lines would show in the spectrum.

But at the eclipse of 1870, visible in Spain, C. A. Young observed these lines to change momentarily from dark lines to bright lines whilst his instrument was directed just ahead of the advancing disk of the moon. The only explanation that could be offered was that when the moon had perfectly obscured the main portion of the sun the enveloping atmosphere close in to the sun's surface was bright enough to give out light of its own. As the phenomenon lasted only a second or so it could be readily computed from the rate of the moon's motion what the depth of such a layer must be and it was found to be less than 1000 miles. Since the phenomenon as just stated lasts but a brief second or two the name "flash" spectrum is particularly appropriate, and each succeeding eclipse has seen improvements in methods of securing permanent records of this fleeting phenomenon.

But other phenomena are even more impressive to the casual observer. The scarlet flames of the prominences, while a wonderful spectacle, never project out from the sun's disk more than about 100,000 miles at the most or about one-tenth of the sun's diameter. But surrounding the sun on all sides is a pearly-gray halo of light which may extend out ten to twenty times that distance or several times the diameter of the sun itself. Until last year it has never been seen or photographed except during totality as its light is relatively very weak. The name "corona" has been given to this surrounding light and studies of the corona are still very desirable as much is yet to be learned concerning it. Its analyzed light

suggests the presence of cosmic matter in the form of solid corpuscles but such matter must be in an exceedingly tenuous state to exist at such great distances from the sun when we consider the enormous attractive power of our central luminary. The spectrum of the corona shows that it shines not only by sunlight reflected from tiny particles within it, but that it is luminous of tself. The nature of the radiation is as yet unknown though to the hypothetical gas responsible for it we have given the name "coronium."

The corona changes its form from year to year. Sometimes it is fairly uniform about the sun; sometimes it extends out in the equatorial very much farther than in the polar direction. There were two eclipses in 1889, one in January and the other in December and in this eleven-month interval quite noticeable changes occurred in its form of the corona.

These changes have now been fairly well linked up with other changes occurring on the sun, though we are far from a complete understanding of the correlation. Almost everyone has heard of the sun-spot cycle in connection with the sun. Sun-spots are like giant volcanoes rifting the solar surface and these come and go in cycles. For some years the surface of the sun will be relatively quiescent; then spots will appear, will increase in number until a maximum is reached. They will then decrease in number until a quiescent stage is again reached. This cycle of changes requires on the average between 11 and 12 years to complete. Now examining photographs of the corona taken from time to time at different eclipses and considering them in relation to the phase of the sun-spot cycle, it soon became evident that when an eclipse occurred at the maximum of sun-spots, the corona was usually of the uniformly regular type. At sun-spot minimum the corona was found to extend out very much farther in the direction of the sun's equator while in the direction at right angles thereto only short little wisps or brushes of coronal light were seen. Many eclipse observers strive to excel in this one particular alone, namely, that of getting beautifully defined coronal photographs. Recent investigations suggest that a study of the prominences for some little interval preceeding an eclipse will enable one to predict the form the corona will have.

With improvements in the methods and technique of colour

photography, it would seem that in the near future successful photographs in colour of the corona and prominences will be an accomplished fact. As previously stated the coronal light is relatively feeble and though attempts have often been made to photograph it apart entirely from an eclipse, such attempts have never been in the least successful until the past year.

THE FALLING PERSEIDS

I stood at midnight by my ripening wheat
To watch the ephemeral Perseid shower fall;
A silent mystery pulsed about my feet,
My heart seemed waiting for some eager call.

So beautiful the earth in glory lay
With golden fields and green lanes deftly wrought;
Unutterable music, far away,
Throbbed with a cadence sweeter than all thought.

Dim stars were darkling in the outer space,
Mileposts of Mystery earth passes night on night;
Through ages gone I've hailed them face to face
And marveled if they shared my keen delight.

And when I saw the fleeting, silver stream
Sweep from vast depths where comets have their birth,
"They're human souls", I said, "tired of that dazzling dream,
Returning to the sweet, cool fields of earth".

Langdon, Alta., August 13, 1932.

BERTRAM HUFFMAN

NEWS AND COMMENTS

VISIT OF ECLIPSE PARTY TO VICTORIA

(With Plate VII)

On Sunday, August 7, a party of twenty distinguished European scientists arrived in Victoria on their tour of North America en route to view the solar eclipse of August 31.

The astronomical members of the party included Dr. F. W. Aston, Nobel prize man, famous for his determinations of the isotopes of many of the elements; D. Carder Davis, F.R.A.S.; D. Duncanson, president of the West of Scotland Branch of the B.A.A.; W. Goodacre, F.R.A.S., of moon map fame; Prof. G. Horn d'Arturo, director of the Bologna Observatory, Italy; Prof. Th. Niethammer, Astronomer at the Basel University, and Mme. Niethammer; M. Paul Helbronner, vice-president of the Astronomical Society of France, and Miss K. Williams, assistant secretary of the R.A.S.

The party was met at the boat by Sir Frank Dyson, Astronomer Royal for England, who had arrived a few days previously, and a committee from Victoria Centre of the Society, consisting of Dr. J. S. Plaskett, J. A. Pearce, Ph.D., W. E. Harper, M.A., and Mrs. Harper, P. H. Hughes, president, and H. Boyd Brydon, secretary of Victoria Centre.

After mutual introductions, the party walked past the rose gardens of the parliament buildings to the Empress Hotel, their abode during their stay, overlooking the harbour, with the Sooke Hills in the distance.

On Monday afternoon the party was driven to the world famous gardens of Mr. and Mrs. Butchart, where tea was served.

That evening a dinner in honour of our visitors was given at the Empress Hotel by Victoria Centre, some twenty members and their wives attending. The president, P. H. Hughes, occupied the chair and was toastmaster.

In welcoming our visitors, the president referred to "this delightful and memorable international gathering with distinguished

MEMBERS OF THE INTERNATIONAL ASTRONOMICAL UNION PARTY AND VICTORIA CENTRE MEMBERS

Photograph taken August 10, 1932, before the Administration Building, Dominion Astrophysical Observatory, Victoria, B.C.

Photograph taken August 10, 1932, before the Administration Building, Dominion Astrophysical Observatory, Victoria, B.C.

1. Hartley
2. Dr Pearce
3. Dr Hogg
4. Hill
5. Marshall
6. Dr Beals
7. Horn d'Arturo
8. Harper
9. Prof Niethammer
10. Miss Miller
11. Dr Aston
12. Thackeray
13. WH White
14. Hibben
15. Mrs Pearce
16. Mrs Brydon
17. Miss Martin
18. Miss Freeth
19. Mrs Hogg
20. Mrs Robinson
21. Mrs Beals
22. Mrs Harper
23. Brydon
24. Goodacre
25. Prof Helbronner
26. Duncanson
27. Miss Williams
28. Sir Frank Dyson
29. Dr Plaskett
30. Lady Dyson
31. Hughes
32. Mrs Plaskett.

KEY TO PLATE VII

representatives of several countries", and expressed the hope that they would find their visit profitable and enjoyable.

Responding to the toast "Our Guests", proposed by Dr. Plaskett, Sir Frank Dyson said, "I think you should encourage the study of astronomy more than we can in England because you can see the skies better." He then gave a comprehensive survey of the International Astronomical Union, its inception being the conferences held in Paris during the nineties for the purpose of working out an astrographic catalogue. From this came the Solar Union, the first meetings being held in Oxford, Paris and at Mt. Wilson, which resulted in the formation of the I.A.U.

Sir Frank spoke with enthusiasm of the work being done by amateurs. In this connection he remarked that in olden times the layman knew more about practical astronomy, the times of sunrise and sunset, new moon and full moon, than to-day. Modern city lighting had dimmed the heavens for most of us, yet too much could not be done in the interests of common scientific knowledge to foster the study of astronomy among ordinary folk.

Sir Frank Dyson's address was followed by short responses, by Prof. Horn d'Arturo of Italy, who spoke in English and Italian; D. Duncanson, Th. Niethammer, who replied in German, and Paul Helbronner, who responded in English. These gentlemen described the encouragement of amateur astronomy in their several countries and were followed by a few words from Miss Williams. These interesting talks were concluded by W. E. Harper, past president, who spoke on the activities of this Society. With the singing of the National Anthem, a most enjoyable evening terminated.

The following afternoon a garden party was attended at Government House, and in the evening the 72-in. telescope at the Dominion Astrophysical Observatory was visited. Unfortunately, clouds prevented any extensive observations.

On Wednesday afternoon an informal discussion on astronomical and physical subjects took place in the administration building of the Observatory, during which Dr. Aston gave a dramatic story of the researches at Cavendish Laboratory, which resulted in the definite establishment of the existence of the neutron. Dr. Paul Helbronner told of the geophysical work he was doing and showed us some of his remarkable panoramic photographs of the

Alps, some of which, beautifully coloured by him, gave a wonderful impression of the high Alpine scenery.

Dr. Plaskett outlined the history of the Observatory; Mr. Harper described his work on the A-stars; Dr. Pearce spoke on his investigations of interstellar matter, proving the rotation of the galaxy; Dr. Beals explained and demonstrated a new photo-electric photometer designed by him; and Dr. Hogg spoke of his work with Mrs. Hogg on planetary nebulae.

Tea was then served by the Victoria Centre, Mrs. W. E. Harper and Mrs. H. Boyd Brydon presiding at the table, assisted by Mrs. J. A. Pearce and Mrs. C. S. Beals, during which sets of photographic views of beauty spots in and around Victoria were presented through the president to Lady Dyson and to Miss Williams, who organized the tour and whose assistance to the writer was invaluable in the numerous arrangements that had to be made.

After the photograph (Plate VII) was taken, Lady Dyson most graciously and charmingly thanked the members of Victoria Centre for the delightful time she and Sir Frank had spent with us.

On Thursday the party left for Seattle, terminating an all too brief visit, during which many old friendships were renewed and new ones made.

H. Boyd Brydon,
Secretary, Victoria Centre.

REVIEW OF PUBLICATIONS

Kosmos, by W. de Sitter, Director of the Observatory and Professor of Astronomy at the University of Leiden. Pp. viii, 138, 5½ × 8½ in., 12 plates and 11 figures in the text. Harvard University Press, 1932. Price, $1.75.

This book contains the substance of six lectures given at the Lowell Institute in November 1931. The subject is the evolution of the ideas of mankind regarding the structure of the universe, and it is needless to say that it is handled in a skilful and convincing manner.

The chapters are:—I. Introduction: Aims and methods of scientific research. The ancients: Ptolemy and Copernicus. The Birth of modern astronomy. Kepler, Galileo, Newton. The eighteenth century. III. The beginning of sidereal astronomy. William Herschel and his successors. IV. Further observational advances. The survey of the "local system". Life-work of J. C. Kapteyn. V. Photography and spectroscopy. The great telescopes. The galactic and the extra-galactic systems. VI. Relativity and modern theories of the universe. Conclusion.

The author shows a critical appreciation of the work of the great astronomers of the past and the present; but in some cases his views do not agree entirely with those given by some historians of astronomy, *e.g.*, the real reason why Tycho rejected the Copernican theory.

A discriminating and accurate outline of Kapteyn's researches is given, and its great significance is explained. The author draws a sharp contrast between Newton's method of purely inductive reasoning and his abhorrence of hypothesis, and the rank (almost fantastic) growth of physical hypotheses of the last twenty years—many of them being short-lived.

Professor de Sitter is usually regarded as next to Einstein himself in the development of the theory of relativity, and in the last chapter he gives an explanation of the meaning of the theory,

and also the significance of the expanding universe, which he was the first to deduce from theoretical considerations.

C. A. C.

Eclipses of the Sun, by S. A. Mitchell, Professor of Astronomy at the University of Virginia, and Director of the Leander McCormick Observatory. Pages xvii, 490, 6 × 8¾ inches, with many illustrations. New York: Columbia University Press, 1932. Price $5.00.

It is a pleasure to see a worthy book reach successive editions. This work first appeared in 1923 and its great value was recognized at once. A second edition came out at the end of the next year, and now we have the third,—revised, enlarged and brought right up to date. One reason for the success of the book is that it is so readable, it appeals both to the professional astronomer and the educated layman. This is perhaps due in part to the author's use of the historical method in treating many of the subjects. When this is well done, as it is in the present case, the reader's human interest is aroused and he proceeds forward as through a biography or any other account of man's achievement.

In this edition full use is made of the advances in atomic and solar physics during the last ten years, and the information acquired in the eclipses of 1925, 1926, 1927, 1929 and 1930 is incorporated. This has introduced much new matter and has added greatly to the value of the work. The last chapters, which deal with theories of the corona and the Einstein theory, are especially interesting. Indeed, one could hardly obtain a better notion of the significance of the theory of relativity and the way it has been verified than by reading chapters 22 and 23. But the whole book is full of information and very interesting.

C. A. C.

NOTES AND QUERIES

Communications are invited, especially from amateurs. The Editor will try to secure answers to queries.

The Solar Eclipse of August 31.

The observations of the recent eclipse were generally disappointing. Over almost the entire belt of totality in Quebec and New England the sky was covered with clouds, though at some places they occasionally separated, soon to come together again. Conditions near the Maine coast were better and the few expeditions which were there were successful; but all the larger expeditions were farther north. At Parent, the British astronomers observed the flash spectrum at the beginning of totality, but I believe they were otherwise unsuccessful. At St. Alexis des Monts the University of Toronto expedition were unable to secure any photographs. The Dominion Observatory (Ottawa), which had located their expedition about seven miles north-west of St. Alexis, was likewise unsuccessful. Cambridge University, under Col. F. J. M. Stratton, Leander McCormick Observatory, under Prof. S. A. Mitchell, which had stations at Magog; Mt. Wilson Observatory under Dr. W. S. Adams, which had chosen Lancaster, N.H.; and the Franklin Institute expedition which was at Conway, N.H.; were all unsuccessful. The Lick expedition under Dr. J. H. Moore and that of the University of Michigan under Dr. H. D. Curtis which were at Fryeburg, Me., were partially successful. Perhaps the French expedition at Louiseville, P.Q., the Japanese astronomers at Alfred, N.H., and the Harvard observers in Maine, were the most successful.

Some R.A.S.C. members at Louiseville and others at Actonvale, had a patch of clear sky among the clouds, while others a mile or two away could not see the sun for the clouds. Some Montreal amateurs near Maskinongé had a clear sky and their report is printed in this issue. The corona was very similar to that of 1922 photographed in Australia.

The International Polar Year. (By Andrew Thomson)

The International Polar Year constitutes the greatest international effort that has ever been undertaken in meteorology, terres-

trial magnetism and aurora. A strong international organization under Dr. LaCour, Director of the Danish Meteorological Service, has worked steadily for three years preparing a general geophysical programme and designing instruments required for stations in high latitudes. Great Britain has set aside 10,000 pounds sterling for a single expedition at Fort Rae, Great Slave Lake, N.W.T.; while France has arranged that the greater part of a grant of four million francs will be reserved for Polar Year work in Greenland.

Canada's participation in this great project is under the supervision of the Meteorological Service. Three expeditions have been sent to points along the coast line of Northern Canada, not far from the Arctic circle, who will carry on their observation programme from September 1, 1932, to September 1, 1933. In addition the Magnetic Observatory at Meanook in northern Alberta has been equipped with three sets of LaCour magnetographs for recording in complete detail the changes occurring in the earth's magnetic field. The Meanook Observatory is at the present time the nearest permanent magnetic observatory to the north magnetic pole.

The largest Canadian party is located at Chesterfield Inlet on the northwest shore of Hudson Bay about 450 miles from the magnetic pole. The staff consists of F. T. Davies, B. W. Currie, S. T. McVeigh and John Rea. The supplies, including food, fuel and equipment required for twelve months' residence, arrived by tug from Churchill, Man., on August 18th. According to the last report on September 10th, the magnetic observatory was almost built and arrangements were completed for erecting a shelter and food depot about 20 miles up Hamilton Inlet where the observers might remain for some days.

Auroral displays would be photographed simultaneously from both the base and second stations. Routine meteorological and pilot balloon observations have been taken since August 25th and further meteorological work including the determination of air temperatures up to ten or fifteen thousand feet by means of kites and light-signalling meteorographs will be undertaken as soon as the magnetographs are in operation. Numerous other investigations bearing on terrestrial physics will be undertaken including measurement of earth currents, solar radiation and atmospheric electric potential.

R. C. Jacobsen is leader of the party at Coppermine on Corona-

tion Gulf just inside the Arctic circle. This party and another at Cape Hope's Advance in Hudson Strait under J. E. Lilly will devote their efforts to meteorology and the aurora.

THE LAYING OF THE CORNER-STONE.

The corner-stone of the Administration Building of the David Dunlap Observatory was laid on the afternoon of September 10. It was a beautiful day, cloudless and pleasantly warm. A rough platform had been constructed from contractor's planks beside the wall, and on it were Mrs. Dunlap, President H. J. Cody of the University of Toronto and a few other friends, while a large number of persons interested in the project, some from a distance, others from the surrounding country, were gathered on the surrounding ground.

The proceedings were in charge of President Cody. In an introductory address he referred to the late David Alexander Dunlap as a man highly respected by all who knew him, sympathetic to all educational and charitable causes, generously spending his income while he lived and at his death leaving noble legacies behind him. Also, he was a keen amateur astronomer, and it was very fitting that his widow, who shared his tastes, should erect to his memory a great observatory. The University has received a number of fine benefactions, and this observatory, in the midst of 179 acres of farmland which will be made into a park, is one of the most notable of these gifts.

At this stage of the proceedings, Mrs. Dunlap presented to Dr. D. Bruce Macdonald, the chairman of the Board of Governors of the University, a document conveying the property to the University.

The President then called upon the present writer, who referred to the occasion when he first met the late Mr. Dunlap. It was in May, 1921, at the close of a lecture on Winnecke's comet, during which an appeal had been made for the establishment of a large observatory in the neighbourhood of Toronto. Mr. Dunlap made himself known to the lecturer and said he was much interested in the project of establishing an observatory. The writer kept in touch with Mr. Dunlap, and had hopes that he would provide the observatory, but to the great regret of all he passed away in the

autumn of 1924. Some three years later the writer approached Mrs. Dunlap and asked if she could consider the project. She replied that she would erect the observatory as a memorial to her husband. Ever since then the scheme has been under consideration. The great 74-inch telescope was ordered over two years ago, and the corner-stone of the Administration Building is now being laid. A few months later the circular metal building for the big telescope will be erected on the summit of the hill two hundred feet to the north. A brief description of the rest of the equipment and a statement of the nature of the work to be undertaken were also given.

Then the stone was lowered to its place in the wall, and with a silver trowel presented by Mr. Eric Haldenby, one of the architects of the building, Mr. David Moffat Dunlap assisted the stone to its final position and declared it laid "to the glory of God and the memory of my father".

Following this, President Cody offered a prayer, and then brief addresses were made by Sir William Mulock, Chancellor of the University and Chief Justice of Ontario, Hon. G. S. Henry, B.A., LL.D., Minister of Education and Premier of the Province, and Hon. G. H. Ferguson, B.A., LL.D., former Premier of Ontario and now High Commissioner for Canada in London, Eng. All referred to the magnificent gift of Mrs. Dunlap, not just to the University but to the whole of Canada.

After cheers for Mrs. Dunlap, those present made their way up to a large tent on the summit of the hill, where refreshments were served through the kindness of Mrs. Dunlap.

C. A. C.

MEETINGS OF THE SOCIETY

AT OTTAWA

April 29, 1932.—This was the last informal technical lecture, for the spring session. Mr. Lane was in the chair.

The speaker of the evening was W. W. Doxsee, M.A., of the Dominion Observatory, and his subject was "Decoding Seismograms".

The lecturer spoke in part as follows: "Earthquakes always occur near the surface of the earth and may be described as abrupt displacements of great rock masses. When such an adjustment takes place the earth reacts as an elastic solid and seismic waves are propagated to all parts of the earth following paths through the body of the earth itself and over its surface. The three outstanding characteristics of seismic waves are the velocity of propagation, the motion of the earth particle and the appearance of the various types on the seismogram. The travel times are the basis of seismological tables from which we calculate the distance between epicentre and recording station, also the time of occurrence of the earthquake at its origin. The motion of the earth particle makes possible the computation of the azimuth of the epicentre from the station, forms a measure of the intensity of the disturbance and also furnishes a means of distinguishing wave types. The appearance of the various wave types on the gram is of primary importance in that correct interpretation is made possible. Those waves which travel through the earth are of two types, compressional and distortional, and they, like other types of waves, may, on coming into contact with a surface with different physical characteristics, become partly or totally reflected, refracted or transposed into a wave of different type. Because of these phenomena and the varying nature of the earth's structure, the character of the seismographic record changes materially as the distance between epicentre and recording station increases. A study of the varying record characteristics due to increased epicentral distance appears to confirm the theory that the earth is composed of at least three zones, a central core of slightly more than half the earth's diameter, a middle or transition zone and the crustal layer of about sixty kilometers thickness, the elastic properties being different in each zone."

Throughout his talk, Mr. Doxsee showed numerous slides to explain various types of seismic waves and to illustrate different points in his lecture. A working model of a seismograph was also exhibited and explained.

Considerable discussion took place at the close of the lecture, and the lecturer kindly answered many questions.

May 28, 1932.—The Ottawa Centre held their last public meeting for the spring session at the Victoria Memorial Museum. Mr. J. S. Lane was in the chair.

The subject of the lecture was "The Total Solar Eclipse of August 31", and there were two speakers. Dr. R. K. Young of the University of Toronto spoke first, dealing with the amateur side of the problem and then Dr. R. E. DeLury of the Dominion Observatory spoke on the subject from the astronomer's stand point.

Dr. Young spoke as follows: "A total solar eclipse is a rare and impressive spectacle. Those now living in Ontario, Quebec and the eastern provinces of Canada will never again have as good an opportunity of viewing this phenomenon as will be presented on August 31st at about 3^h 24^m. The total eclipse will be visible in a belt about 100 miles wide running from Hudson's Bay down through Quebec in a southeasterly direction. The eastern edge of the belt cuts the St. Lawrence river about 25 miles east of Three Rivers and the western edge passes through the city of Montreal. It includes the city or towns of Montreal, Sherbrooke, Magog, Louiseville, Three Rivers, Fortierville, Shawinigan Falls, Parent, Sorel and many other places.

An eclipse of the sun affords astronomers an opportunity to study portions of the sun which cannot be seen at any other time and consequently the coming eclipse will be studied both in Canada and the United States by parties coming from many countries of the world. Their investigations will include studies of the exact time of the eclipse, deducing tht position of the shadow of the moon on the earth and the time of the eclipse. From these the positions of the sun and moon may be accurately computed, and also departures in the earth's uniform rate of rotation. They will also include the taking of pictures of the outer atmosphere of the sun, called the corona, with very powerful cameras to show the details of its structure. Photographs will also be taken with the spectroscope to determine the constitution of the various layers in the atmosphere of the sun, and others to reveal how much light of the outer atmosphere is reflected sunlight as well as to determine the total light. Photographs in colour will bt madt as well as movie pictures to show the general progress of the eclipse. The Einstein theory of relativity will again be tested by measuring the displacement of the stars near the sun.

While the eclipse is of extreme interest to the professional astronomer it will also be of great interest to the amateur and to everyone who has an opportunity to witness it. The amateur through lack of apparatus cannot engage in the problems mentioned above, but he may contribute valuable observations of related phenomena. These include changes in temperature as the eclipse progresses, shifts in the direction of the wind or its strength, changes in any cloud formations if such are present.

Just prior to the oncoming of the total phase the observer will notice peculiar shadows on the ground and astronomers would like to have observations of these from as many points in the path of totality as possible. The point of observation of the observer should be accurately given, the time when the shadows were seen, the way they seemed to move in regard to speed or direction and any peculiarities which may be noticed. Observa-

tions of those living very near the edge of the shadow track will be of great value in fixing the exact position of the shadow.

Those who go to see the eclipse, might care to answer the following questions:

1. Where were you, when you observed the eclipse? Give directions to locate your position as accurately as possible. A map marking roads, rivers, railways, buildings or trees nearby will be of great help.

2. Was there any time when the whole disk of the sun was completely covered? If so, estimate how long the disk remained covered.

3. Did you see streamers projecting out from the sun which you thought belonged to the corona of the sun?

4. With the advent of totality could you see any buildings, church spires or trees which were definitely in the sunshine and others which were in the shade? If so, make a sketch showing where the edge of the shadow seemed to pass in your locality.

The eclipse occurring as it will at a very pleasant time of the year, and a convenient hour of the day, will doubtless be viewed by millions of people. The chances of clear sky at this time are very good, but, however the conditions happen to be at the critical time, it is to be hoped that a very great many will be prepared to make observations if the weather permits."

Following Dr. Young's lecture, there was a short motion picture reel depicting the motions of sun, moon, and earth, and the necessary conditions for a total eclipse to occur.

This was followed by a short address by Dr. DeLury, dealing more with the technical problems to be studied at a total solar eclipse, and the proposed plans of the official party to be sent by the Dominion Observatory.

Both talks were illustrated by many interesting lantern slides. Mr. Lane thanked both speakers on behalf of the audience for their enlightening addresses.

MIRIAM S. BURLAND, *Secretary.*

AT VICTORIA

The second session of the summer study group again brought together an enthusiastic gathering of members. The speaker was W. E. Harper, M.A., Assistant Director of the Dominion Astrophysical Observatory, who discussed with charts and photographs, the more important features of the summer constellations, and pointed out their relative positions on the celestial sphere.

After the lecture the class adjourned to the open air and identified several of the constellations. During part of the period seeing conditions were good, and several double stars were examined with the telescope. Clouds brought the meeting to a close.

At the third session the subject for discussion was Systems of Co-ordinates. In opening, Mr. H. Boyd Brydon said that the co-ordinates of a

point in space were simply the mathematical way of stating its address. The three principal systems of co-ordinates, the Horizon System, the Equatorial System and the Ecliptic System, were then described and illustrated on a large coelosphere.

The fourth session was opened by Dr. J. A. Pearce, who reviewed with questions, the work of the previous week, and the relations of the three systems to each other, following this with a simple method of determining latitude by the altitude of Polaris, the experiment being performed, using "Altimeters" designed by Dr. Pearce, by many of those attending, at the conclusion of the lecture period. James Duff, M.A., then took up "The Earth, its Shape and Size", describing the proofs of its being an oblate spheroid and the absurdities reached on the basis that it was flat.

The fifth meeting was occupied by a discussion of the moon by Mr. Chas. Hartley, and was illustrated by numerous drawings and lantern slides.

Solar and Sidereal time were discussed by Dr. C. S. Beals at the sixth session, and their differences explained. Excellent observations of Saturn were obtained by members at the conclusion of the meeting.

The seventh meeting was addressed by Dr. F. S. Hogg, who spoke most interestingly on "Visual Variables". After a brief reference to novae, Dr. Hogg described the principal types of variable stars, namely, Eclipsing variables, type star Algol; the short period pulsating stars, type δ Cephei with the sub-class having periods of a day or less, principally observed in the clusters whence they are known as cluster variables; the long period (100 to 500 days) stars such as χ Cygni; and the irregular variables, as *o* Ceti.

Argelander's comparison method for determination of magnitude was explained, following which lantern slides of the typical forms of light curves were shown.

The observational period was used to examine the Ring nebula in Lyra, the Andromeda nebula, the Hercules cluster, and the double cluster in Perseus.

H. Boyd Brydon, *Secretary.*

AT EDMONTON

March 1, 1932.—The first meeting of the newly-authorized centre as such was held in the Arts Building, University of Alberta, with Dr. J. W. Campbell acting as chairman. A letter from Dr. R. K. Young, president of the Society, giving permission to form the Edmonton centre, was read. Then, to have some starting point from which to work, and on which to build the new constitution, the by-laws and constitution of the London centre were proposed, the result being their almost entire adoption.

The speaker for the evening was Mr. Kenneth E. McShane, who gave a short talk on the variable star Algol, whose variability is due to its being a double star, the two components revolving about each other. Variable stars of this type are known as "eclipsing binary" stars. The fluctuations in

brightness are caused by the difference in magnitude of the pair, and the fact that now one, now the other, is eclipsed. In a broad outline, Mr. McShane explained the other types of variables, including the Cepheids.

A nominating committee was chosen to present a list of candidates at the next meeting.

March 15, 1932.—The second meeting of the Edmonton centre was held in the Arts Building, University of Alberta. Dr. Campbell was in the chair. The address of the evening was given by Mr. Hugh Beach, who spoke on the subject of "The Moon". He spoke briefly of its chief characteristics, describing the craters and explaining its eclipses and motions. This was illustrated by diagrams and lantern slides.

Dr. J. R. Tuck, a chairman of the nominating committee, presented the slate of candidates prepared by the nominators. Voting then took place, the officers elected being those already reported in this JOURNAL.

April 12, 1932.—The third regular meeting of the Edmonton centre was held in the Arts Building, University of Alberta, at 8.15 p.m., Dr. J. W. Campbell, the president, in the chair. Two new members, Mrs. J. M. Clindinin and Mr W. A. McAulay, were introduced and their membership approved.

Dr. Campbell gave a five-minute talk on the sky for April, and explained the reason for the varying heights of the moon, showing the absurdity of the old superstitions that weather conditions vary according to the position in which the moon rises. He then introduced the speaker for the evening, Dr. E. H. Gowan, of the Department of Physics, University of Alberta, whose topic was "Meteors".

This subject was treated more from the geophysical rather than from the usual point of view, since this is in line with Dr. Gowan's own work. By meteors, he said, we usually mean meteorites, which reach the surface of the earth, and meteors, which do not. The common constituents of those meteorites that have been found are familiar enough to us—sodium, lithium, tellurium, arsenic, antimony, cadmium, iron, potassium, hydrogen, carbon, oxygen, sulphur, chlorine, and so on.

Meteorites may be divided into two classes—the iron type, which comprise one-tenth of the meteorites found, and contain 3-18% nickel; and the stone type, which are similar to lava and the meteoric rocks. In size, meteors may be as small as the head of a pin. Sometimes a large number are observed, and their positions noted on maps. Now, if their paths are followed backwards, they may be observed to intersect more or less approximately. Such a group is called a family, and the point from which they appear to radiate is their radiant point. Such families are designated by names derived from the constellations near which they occur; for instance, we have Leonids and the Andromids.

Some years ago a controversy arose in England as to whether or not meteors made a noise. After a meteor was seen, it was found that within a small circle it had been heard. Outside of that in a concentric circle it

had been seen but not heard. The reason for this is that the sound, striking the earth over a small area, had been reflected upwards again, and beneath this area of reflection no sound had been heard. The sound waves, travelling high above the ground, had then struck a denser layer of air, which had in turn reflected them down so that the noise was heard outside the silent area.

By having two observers some miles apart who are recording simultaneously, Dr. Gowan said it is possible to find the exact position and altitude of the recorded phenomena.

May 10, 1932.—The fourth regular meeting of the Edmonton centre was held in the Arts Building, University of Alberta, at 8.15, Dr. Campbell in the chair. Mr. Harold Poole gave a five-minute talk on "Mars and Saturn", which are prominent objects in the May sky in the morning.

The address of the evening was given by Mr. Ken Alexander, on the subject of "Eclipses", this subject having been specially selected in view of the coming eclipse of the sun, visible in eastern Canada in August. Mr. Alexander illustrated by diagrams the two kinds of eclipses, and showed how to find the maximum and minimum ecliptic limits. He pointed out that the greatest number of eclipses possible in any year was seven, and the least number, two.

This proved to be a very interesting topic, several members recalling eclipses that they had seen in various parts of the world.

As this was the last regular meeting of the spring, it was made especially enjoyable by the serving of refreshments at its conclusion. The telescope was set up outside, and the members were able to observe the moon.

June 6, 1932.—A special meeting of the Edmonton centre was called for June 6, in the form of a banquet in Athabasca Lounge, University of Alberta, at 7 o'clock. The guests of honour on this occasion were a party of British scientists, headed by Mr. J. M. Stagg of the British Meteorological Service. This party was passing through Edmonton on its way to Fort Rae on Great Slave Lake, North West Territories, to make a thirteen-month study of meteorology, terrestial magnetism and the aurora borealis. Dr. Campbell, the chairman for the evening, introduced each of the six scientists in turn; then Mr. Stagg gave a most interesting outline of the work they plan to carry out, describing methods and instruments to be used. Two stations are to be established twenty-five miles apart, he said, to make simultaneous observations, for the purpose of determining the position, cause and effect of the northern lights. Conditions in the upper atmosphere will be recorded by instruments sent up by means of balloons, and automatically released; and instruments of the greatest precision will record magnetic fluctuations.

This is the fiftieth anniversary of the first Polar Year, and other nations, notably Russia, are co-operating by the establishment of northern stations to make the data obtained produce results of the greatest possible value to science.

Almost forty members were present.

FRANCES M. FISHER, *Secretary.*

AT HAMILTON

May 8, 1932.—The regular meeting of the Hamilton Centre was held in the lecture hall of the Public Library. The president was in the chair.

The reading of the minutes of the previous meeting was followed by a short address by Mr. J. A. Marsh, on what could be seen by the naked eye at a total eclipse of the sun.

The speaker of the evening was Rev. Dr. D. B. Marsh, of Norwich, who is our honorary president. He gave a description of the preparations and actual photographing of the eclipse in 1925, from Yale University campus. The crowd was tremendous, and many policemen were needed to keep them from crowding the instruments. Seventeen photographs were taken in one and one-half minutes. Dr. Marsh described the weird appearance of surrounding objects when totality approaches and the beautiful appearance of the corona with the calcium and hydrogen flames. Some of the important discoveries made at former eclipses were explained and this centre hopes to add to these this summer.

June 9, 1932.—The regular meeting took the form of a field night, and was held at the residence of Mr. W. T. Goddard.

About one hundred people enjoyed the opportunity of viewing the sky through the telescopes set up for the use of the members and their friends.

The Moon, Venus and Jupiter were viewed clearly, but it was disappointing that the sky clouded over during the latter part of the evening. However, during the cloudy intervals the time was spent in discussing many interesting questions regarding the moon and planets. The discussion groups were led by J. A. Marsh, W. S. Mallory and Professor Findlay.

An enthusiastic welcome greeted the announcement that weather permitting, another field night would be held on Saturday, June 11th.

Four telescopes were set out and were in charge of W. S. Mallory, Professor Findlay, J. A. Marsh and S. W. Scammell.

Light refreshments were served, and the society tendered thanks to Mr. and Mrs. Goddard as host and hostess.

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to Volumes 1-25 of the Journal of the Royal Astronomical Society of Canada and to its previous publications (dating from 1890) is now ready.

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